ACQUISITION OF ACOUSTIC MODEMS FOR UNDERWATER COMMUNICATIONS AND REMOTE SENSING AND ACOUSTIC MODEM POOL AT WOODS HOLE OCEANOGRAPHIC INSTITUTION

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LONG-TERM GOALS

The long-term goal of these programs is the acquisition and continuing support of twenty state-of-the-art acoustic modems that will be made available to researchers in the oceanographic community. This pool of instruments will provide researchers from universities, Navy laboratories, and related groups the tools they need to communicate reliably via the acoustic channel. The Acoustic Modem Pool will be a self-supporting facility once the original inventory has been acquired.

OBJECTIVES

Because acoustic modems capable of high rate communications in difficult acoustic environments are not commercially available, we have designed a Utility Acoustic Modem, or UAM, to meet this need. Its specifications are shown in Table 1. Small, power efficient, reasonably priced modems with straightforward interfaces to a variety of peripheral equipment are needed for point-to-point communications, as communications nodes in underwater networks, and as sensors for acoustic remote sensing. UAMs will be fabricated and tested by WHOI and then placed in the Modem Pool. A plan for managing the Modem Pool will be developed to ensure access to the instrumentation and to track modem performance.

APPROACH

The design approach for the UAM was driven by the performance specification and by size, cost, and power constraints. A single board processor design with small daughter boards for receiver input and the power amplifier was chosen for reliability, size, and cost reasons. The main processor, a TMS 320-C-44 DSP chip supplies processing speed, low power operation, and compatibility with existing communications software and the AMS operating system. This design provided the flexibility to operate with almost any communications protocol and modulation scheme and to monitor performance and manage power efficiently. It also made it possible to package the modem for use in the ocean in a compact package.

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WORK COMPLETED

Parts for twelve of the twenty UAMs have been ordered and five complete units have been built and tested. The device meets the design specifications and exceeds them in some important respects. Of particular note are: 1) power consumption is approximately one-half of the anticipated value (4 watts rather than 8 watts), 2) the operating voltage range is wider (5.5 to 20 V) than specified, allowing a wider range of battery power sources, and 3) the noise performance of the acquisition subsystem is completely satisfactory over a dynamic range of more than 100 dB. Each of the UAMs include a three-board set, a housing, and a battery pack.

The first at-sea test of the UAM took place in October 1997 as part of the AOSN-Labrador Sea Test Cruise. Five UAMs from the Modem Pool were used with excellent results. Highlighting the versatility of the device, UAMs were used for USBL homing on Odyssey AUVs, as coherent and incoherent signaling transmitters, and as a beacon. Selection of the operating mode of each UAM was achieved through the host port and so did not require opening up the pressure housings.

An Acoustic Modem Pool has been established. Six modem cores built by Lockheed Sanders have been placed in the pool and two are on loan to Dr. Frank Caimi at Harbor Branch. Two UAMs have been provided to Odyssey AUV operators at WHOI and MIT. Procedures are in place for making the property transfers and tracking and maintaining the equipment.

IMPACT/APPLICATIONS

The potential of the UAM is far reaching. It has application in underwater research, underwater defense, commercial operations such as oil exploration and production, and in recreational areas. It has the potential to be a basic tool that can be applied to a multitude of underwater communication situations just as the radio can be applied to surface communication problems.

TRANSITIONS

The initial transition of the UAM will be to the MURI-AOSN program where a total of six or eight modems will be used during the Labrador Sea experiment scheduled for January 1998. It is anticipated that other AUV programs will also be incorporating UAMs in their vehicles. Modems will be supplied via the Modem Pool.

RELATED PROJECTS

MURI-AOSN: Project to utilize a combination of fixed and mobile measurement platforms to observe an ocean volume with high resolution in space and time. UAMs will provide underwater connectivity between various platforms and vehicles.

Table 1: UAM Specifications

Size:

- 8 x 3.5” - Main board
- 3.5 x 3.2” - Power amplifier board
- 3.5 x 3.2” - Input board - 4 or 8 channel

Power:

- Receive: $\leq$ 4 watts
- Transmit: $\leq$ 30 watts

Main Board:

- 60 MHz TMS 320C-44
- 4 ADC channels - 0-100 kHz sample rate
- 2 DAC channels - 0-100 kHz sample rate
- Real-time clock
- 2 Serial ports

Power Supply:

- Main supply - 5.5 - 20V
- Reserve supply - 5.5 - 10V

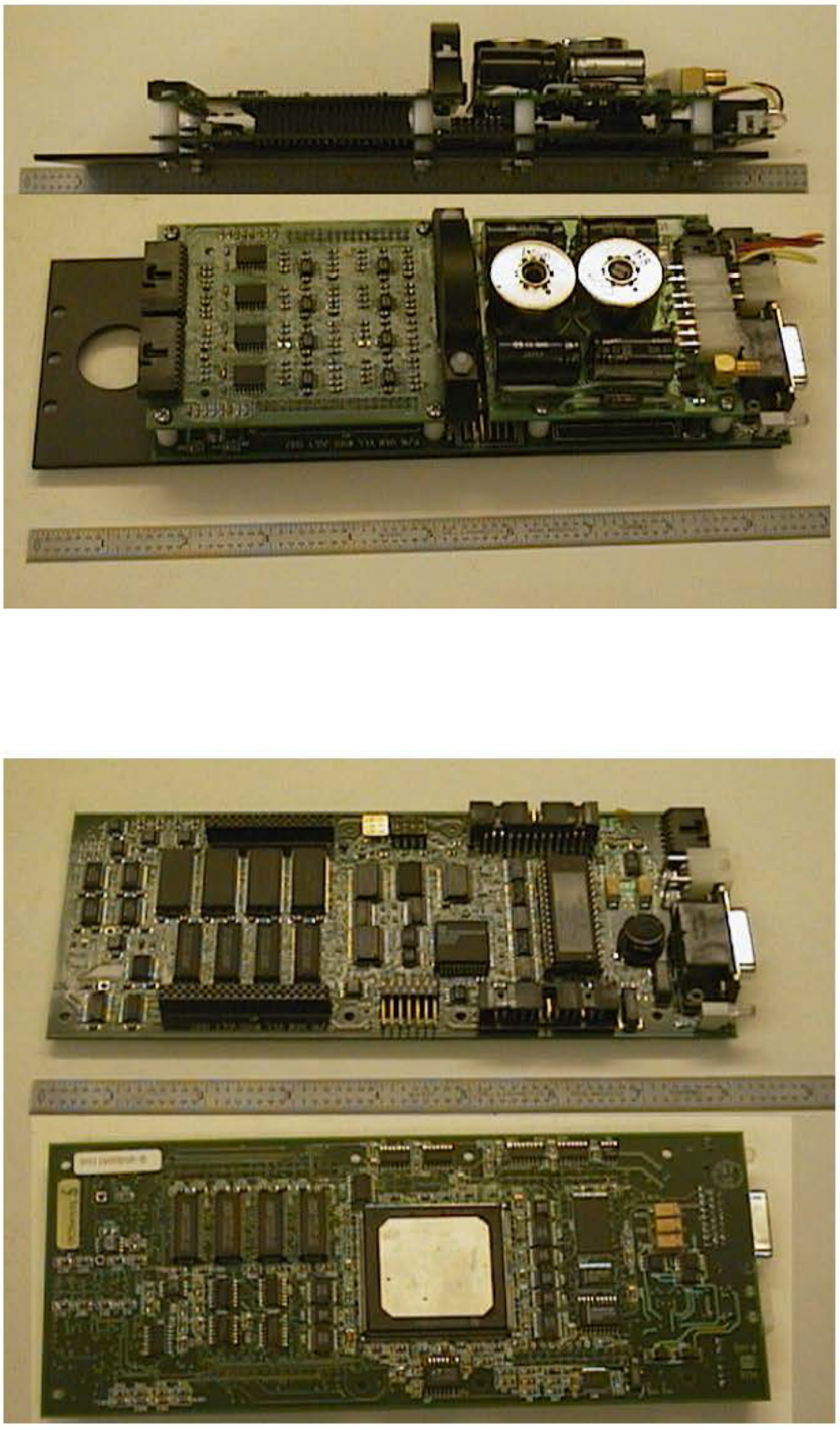

Figure 1: Photos of UAM boardset